

ASSUMPTIONS FOR ESD COST ESTIMATES

GENERAL

1. The 2009 Explanation of Significant Differences (ESD) for Lower Harbor Confined Aquatic Disposal [CAD] Cell (LHCC) cost estimates were prepared following EPA's guidance document, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*. EPA 540/R-00/002, July 2000. These are order-of-magnitude engineering cost estimates that are expected to be within -30 to +50 percent of the actual project cost.
2. Information in the cost estimates is based on the best available information regarding the anticipated scope of the remedial alternative at this time. Changes in the cost elements are likely to occur as a result of new information and data collected prior to the detailed design of the remedial alternative.
3. When possible, actual costs from similar activities have been used to derive estimated costs. Because actual costs are inclusive of all aspects of an activity, including overhead and support costs, they are generally more accurate than an itemized cost estimate.
4. Fixed costs have been grouped and applied annually to the cost estimates. Fixed costs comprise costs for planning and reporting, contractor project management, mobilization and demobilization, operational sampling and analysis, site operation & maintenance (O&M), NAE expenditures, sediment sampling and water quality monitoring, and O&M of the data in the database and on the EPA web site. The fixed costs are based on historical experience and costs associated with this project performed in previous years.
5. Project duration is the time from the start of the project until the site is demobilized. It has been assumed that the ESD will be approved in calendar year 2010 and the project will start in 2010. Project duration does not include any long term monitoring (LTM) beyond the final year of remedial operations.
6. Capital, annual, and periodic costs used in the present value calculations have been escalated from the time the cost was generated to the base year (2010). An escalation rate of 3.5 percent has been used.
7. A discount rate was used for present value calculations per U.S. Environmental Protection Agency guidance (July 2000) and Office of Management and Budget Circular A-94, revised December 2008 (www.whitehouse.gov/omb/circulars/a094/a94_appx-c.html). Based on project lifetime, a discount rate of 1.8% was used for the \$80M/year funding scenarios; a discount rate of 2.9% was used for the \$30M/year funding scenarios; and a discount rate of 2.7% was used for the \$15M/year funding scenarios.

8. None of the alternatives include land use control implementation, property leases, or project closeout cost. Land use controls implementation, property leases, and project closeout costs are assumed to be similar for all alternatives, and have been omitted from all cost estimates.
9. The volume of contaminated material to be removed is the same for all alternatives. The total volume of material to be removed from all MUs is 804,474 cubic yards (CY) (assume MU-37 was reduced by 10,000 CY from pilot cap)¹. It has been assumed by EPA that cleanup passes will be required in MUs 1-24 and MUs 102-105, which will add 53,351 CY to the volume of material to be dredged. According to post-dredge bathymetric surveys, 108,561 CY of material were dredged through the 2008 dredge season; and it is anticipated that 56,400 CY of material will be dredged in 2009. Therefore, for the purposes of the ESD cost estimates, the remaining volume of material to be removed from the MUs is 692,864 CY. The wetlands requiring remediation (VUs) comprise 47,976 CY.
10. The cost estimates to build and cap the confined disposal facilities (CDFs) were developed by NAE in December 2007. The estimates did not include costs to maintain the CDFs during their construction and operation, and those costs were added for the purpose of this cost estimate. The cost to construct each CDFs appears as a portion of the total cost, proportional to the volume of the respective CDF.
11. Monitoring well construction costs are shown in the actual year of construction. It is assumed that additional chemical and hydraulic studies will not be required for selection of monitoring well locations. It is assumed that pumping tests will not be performed on the wells.
12. Specific assumptions for individual alternatives are included in the individual cost estimating spreadsheets.

ALTERNATIVE 1, \$15M/YEAR FUNDING SCENARIO

Alternative 1 is removal of contaminated sediments by hydraulic dredging with two disposal methods, as currently allowed in the 1998 New Bedford Harbor Site Upper and Lower Harbor Operable Unit Record of Decision (ROD): transportation and disposal (T&D) to a certified hazardous waste landfill; and disposal in three local shoreline CDFs. The total capacity of the planned CDFs is approximately 210,000 CY. The sand from the dewatering operations (assumed to be 10% of the total sediment volume, or 69,286 CY) will be disposed of in the CDFs. The remaining 140,714 CY capacity of the CDFs will be filled with filter cake. This leaves 240,361 CY of filter cake to be shipped to a certified landfill.

¹ Foster Wheeler for USACE, *Volumes, Areas and Properties of Sediment by Management Units*, Rev 2, September 2003, Table 1 Physical Design Values.

For the \$15M/year funding scenario of Alternative 1, the project lifetime is 46 years. Hydraulic dredging and dewatering occur all years, with the exception of years when CDFs are built and capped, and years when wetlands, Marsh Island, and Cell #1 remediation are performed. Hydraulic dredging occurs in 32 of the project years.

Per EPA direction, the more highly contaminated filter cake (produced from earlier years of dredging) will be shipped off site so that the filter cake with lower levels of contamination can be disposed of in the CDFs. For the purposes of this cost estimate, it is assumed that all sand and oversize material from hydraulic dredging will be disposed of in the CDFs. Therefore, construction of CDF A and the monitoring wells for CDF A LTM will begin in Project Year 1 and will take three years. Hydraulic dredging will occur from Years 4–24 with disposal of sand into CDF A and shipment of filter cake to a certified landfill. Sand could be disposed into CDF A as it is produced or stock-piled and disposed in larger batches. In Years 25–26 CDF B will be constructed to contain the filter cake generated in Years 27–31. CDF C will be constructed in Years 32–34 for disposal of the remaining filter cake. In the final year of construction of each CDF, costs are included for installation of monitoring wells to perform LTM of each CDF. Monitoring of each CDF will commence the first year material is placed in the respective CDF.

At the conclusion of the hydraulic dredging activities in each MU, confirmational sampling will be performed to allow movement of the sheet piles and dredge to the next MU. A cost of \$250,000 for confirmational sampling (total) was estimated at a discussion on 01 February 2009 with EPA, NAE and Jacobs. For the purposes of this cost estimate, the \$250,000 is divided evenly over the 32 dredging years for an annual confirmational sampling cost. The wetlands confirmational sampling is included in the wetlands remediation unit rate.

Wetlands Remediation will occur in Project Years 42–44, after hydraulic dredging and Marsh Island Restoration are completed. A detailed cost estimate for wetlands restoration was developed for EPA in December 2007 (“Cost Estimate 1b”). The estimate included building temporary roads to access the wetlands, removal and T&D of material, backfilling, planting, and temporary road removal. The 2007 cost estimate was modified in April 2009 for the Alternative #4 One CAD Cell Approach cost estimate by adjusting the wetlands area from *Volumes, Areas and Properties of Sediment by Management Units*, likewise adjusting linear feet of access roads, and including installation of silt curtains around the excavation areas. The NAE estimated the cost for the Marsh Island Restoration in 2007 at \$2.61M. On 15 December 2008 EPA suggested increasing the cost to \$2.75M to cover oversight and other costs.

In addition to the construction of the CDFs and installation of CDF monitoring wells, the following capital costs have been included in this cost estimate.

- Narragansett LTM is performed periodically by EPA, and for Alternative 1 \$15M/year is scheduled to be performed in Project Years 1 and 5. The basis for the cost is an EPA e-mail dated 23 January 2009 assuming the cost to be \$400,000 each event.

- The NStar Crossing is assumed to occur in Project Year 2. This is a cost for relocating power lines that pass under the Acushnet River and must be relocated to complete the dredging. The cost included in this estimate was increased from a 2007 estimate of \$1.2M due to an assumption that copper costs will increase. As discussed in a meeting with EPA, NAE and Jacobs on 01 February 2009, the estimate is \$3M in 2009 dollars.
- In Project Year 3, a capital cost has been included for re-competition of the TERC contract. The cost associated with re-competing the contract was provided by NAE in 2007 as \$983,404.
- In Project Year 45, Cell #1 at Area C will be emptied, the material shipped to a hazardous waste landfill, and the area will be capped. The cost of \$15,573,194 was derived from a similar estimate prepared by Jacobs in February 2008 for EPA, Cost Est 2bcf.
- Following completion of hydraulic dredging, equipment and facilities associated with hydraulic dredging in Areas C and D will be demobilized. The demobilization cost for Areas C and D is the escalated rough order of magnitude (ROM) estimate prepared by Jacobs in December 2007 (\$9,875,524) and includes complete demobilization and decontamination of equipment. This cost is carried in Year 46.

ALTERNATIVE 1, \$30M/YEAR FUNDING SCENARIO

EPA has requested that the cost estimating method for this alternative and funding scenario deviate from the EPA guidance and show a 3.5% annual escalation of cost each project year while maintaining a fixed funding level (i.e., not escalating the annual funding). The \$30M/year funding level was maintained until Project Year 20 at which time a minimum of 40 days of hydraulic dredging could not be maintained along with the fixed costs. For Project Years 20-27 the minimum number of hydraulic dredging days was set at 40, and the annual escalated cost rose as a result. In Project Years 28-40 the annual costs are greater than \$30M due to the continually escalating fixed costs, and the need to complete CDF capping, wetland restoration, and demobilization in a reasonable timeframe. To maintain an average annual cost of \$30M while escalating the annual costs, the project lifetime increased from 20 years to 40 years.

Alternative 1 is removal of contaminated sediments by hydraulic dredging with two disposal methods, as currently allowed in the ROD: T&D to a certified hazardous waste landfill; and disposal in three local CDFs. The total capacity of the planned CDFs is approximately 210,000 CY. The sand from the dewatering operations (assumed to be 10% of the total sediment volume, or 69,286 CY) will be disposed of in the CDFs. The remaining 140,714 CY capacity of the CDFs will be filled with filter cake. This leaves 240,361 CY of filter cake to be shipped to a certified landfill.

For the \$30M/year funding scenario of Alternative 1 with annual escalation of 3.5%, the project lifetime is 40 years. Hydraulic dredging and dewatering occur in Years 2-28; hydraulic dredging occurs in 27 of the project years. Capping of the CDFs occurs in Years 28 and 29, as soon as hydraulic dredging is completed. Remediation of the wetlands, Marsh Island, and Cell #1 are performed subsequently in Years 29-40.

A detailed cost estimate for wetlands restoration was developed for EPA in December 2007 ("Cost Estimate 1b"). The estimate included building temporary roads to access the wetlands, removal and T&D of material, backfilling, planting, and temporary road removal. The 2007 cost estimate was modified in April 2009 for the Alternative #4 One CAD Cell Approach cost estimate by adjusting the wetlands area from *Volumes, Areas and Properties of Sediment by Management Units*, likewise adjusting linear feet of access roads, and including installation of silt curtains around the excavation areas. The NAE estimated the cost for the Marsh Island Restoration in 2007 at \$2.61M. On 15 December 2008 EPA suggested increasing the cost to \$2.75M to cover oversight and other costs.

Because 240,361 CY of filter cake will require T&D to a certified landfill under Alternative 1, for the \$30M/year funding scenario construction of CDF A and the monitoring wells for CDF A LTM will occur in Project Year 1 and no hydraulic dredging will take place that year. Hydraulic dredging will occur from Years 2–9, generating sand and filter cake that will be disposed of into CDF A. Approximately 107,000 CY of filter cake will be shipped to a landfill those years. For the purposes of this cost estimate, it is assumed that all sand and oversize material from hydraulic dredging will be disposed of in the CDFs. Sand could be disposed into CDF A as it is produced or stock-piled and disposed in larger batches. In Years 4-8 CDF C will be constructed to contain the sand, oversize and filter cake generated in Years 9-15. In Years 12-15 CDF B will be constructed for disposal of the sand, oversize and filter cake from Years 16-28. The cost for capping all three CDFs is included in Years 28 and 29 for the purposes of this cost estimate, but in practice each cap would be constructed as each CDF is filled. In each year CDF construction is completed, a capital cost is included for installation of monitoring wells to perform LTM of each CDF. The LTM cost for each CDF is assumed to be one third of the total LTM costs, which was derived from similar monitoring activities ongoing at the site. Monitoring of each CDF will commence the first year material is placed in the respective CDF.

At the conclusion of the hydraulic dredging activities in each MU, confirmational sampling will be performed to allow movement of the sheet piles and dredge to the next MU. A cost of \$250,000 for confirmational sampling (total) was estimated at a discussion on 01 February 2009 with EPA, NAE and Jacobs. For the purposes of this cost estimate, the \$250,000 is divided evenly over the 27 dredging years for an annual confirmational sampling cost. The wetlands confirmational sampling is included in the wetlands remediation unit rate.

In addition to the construction of the CDFs and installation of CDF monitoring wells, the following capital costs have been included in this cost estimate.

- Narragansett LTM is performed periodically by EPA, and for Alternative 1 \$30M/year is scheduled to be performed in Project Years 1 and 5. The basis for the cost is an EPA e-mail dated 23 January 2009 assuming the cost to be \$400,000 each event.
- The NStar Crossing is assumed to occur in Project Year 2. This is a cost for relocating power lines that pass under the Acushnet River and must be relocated to complete the dredging. The cost included in this estimate was increased from a 2007 estimate of \$1.2M due to an assumption that copper costs will increase. As discussed in a meeting with EPA, NAE and Jacobs on 01 February 2009, the estimate is \$3M in 2009 dollars.
- In Project Year 3, a capital cost has been included for re-competition of the TERC contract. The cost associated with re-competing the contract was provided by NAE in 2007 as \$983,404.
- In Project Years 36-38, Cell #1 at Area C will be emptied, the material shipped to a hazardous waste landfill, and the area will be capped. The cost of \$15,573,194 was derived from a similar estimate prepared by Jacobs in February 2008 for EPA, Cost Est 2bcf.
- Following completion of hydraulic dredging, equipment and facilities associated with hydraulic dredging in Areas C and D will be demobilized. The demobilization cost for Areas C and D is the escalated ROM estimate prepared by Jacobs in December 2007 (\$9,875,524) and includes complete demobilization and decontamination of equipment. This cost is carried in Years 39 and 40.

ALTERNATIVE 1, \$80M/YEAR FUNDING SCENARIO

Alternative 1 is removal of contaminated sediments by hydraulic dredging with two disposal methods, as currently allowed in the ROD: T&D to a certified hazardous waste landfill; and disposal in three local CDFs. The total capacity of the planned CDFs is approximately 210,000 CY. The sand from the dewatering operations (assumed to be 10% of the total sediment volume, or 69,286 CY) will be disposed of in the CDFs. The remaining 140,714 CY capacity of the CDFs will be filled with filter cake. This leaves 240,361 CY of filter cake to be shipped to a certified landfill.

For the \$80M/year funding scenario of Alternative 1, the project lifetime is 6 years. Hydraulic dredging and dewatering occur all years, with the exception of Project Year 6, when wetlands remediation is completed.

Construction of the CDFs and the monitoring wells for LTM will begin in Project Year 1; filling and LTM will begin in Project Year 2. The sand from Dredge Season 1 will be stockpiled while the first CDF is constructed.

Wetlands Remediation will begin in Project Year 4. Under the \$80M/year funding scenario, this activity can occur simultaneously with hydraulic dredging. A detailed cost estimate for wetlands restoration was developed for EPA in December 2007 ("Cost Estimate 1b"). The estimate included building temporary roads to access the wetlands, removal and T&D of material, backfilling, planting, and temporary road removal. The 2007 cost estimate was modified in April 2009 for the Alternative #4 One CAD Cell Approach cost estimate by adjusting the wetlands area from *Volumes, Areas and Properties of Sediment by Management Units*, likewise adjusting linear feet of access roads, and including installation of silt curtains around the excavation areas.

At the conclusion of the hydraulic dredging activities in each MU, confirmational sampling will be performed to allow movement of the sheet piles and dredge to the next MU. A cost of \$250,000 for confirmational sampling (total) was estimated at \$50,000/year for each year hydraulic dredging occurs per discussion on 01 February 2009 with EPA, NAE and Jacobs. The wetlands confirmational sampling is included in the wetlands remediation unit rate.

In addition to the construction of the CDFs and installation of CDF monitoring wells, the following capital costs have been included in this cost estimate.

- Narragansett LTM is performed periodically by EPA, and for Alternative 1 \$80M/year is scheduled to be performed in Project Years 1 and 5. The basis for the cost is an EPA e-mail dated 23 January 2009 assuming the cost to be \$400,000 each event.
- The NStar Crossing is assumed to occur in Project Year 2. This is a cost for relocating power lines that pass under the Acushnet River and must be relocated to complete the dredging. The cost included in this estimate was increased from a 2007 estimate of \$1.2M due to an assumption that copper costs will increase. As discussed in a meeting with EPA, NAE and Jacobs on 01 February 2009, the estimate is \$3M in 2009 dollars.
- In Project Year 3, a capital cost has been included for re-competition of the TERC contract. The cost associated with re-competing the contract was provided by NAE in 2007 as \$983,404.
- In Project Year 4, Cell #1 at Area C will be emptied, the material shipped to a hazardous waste landfill, and the area will be capped. The cost of \$15,573,194 was derived from a similar estimate prepared by Jacobs in February 2008 for EPA, Cost Est 2bcf.
- Due to the proximity of Marsh Island to the lower harbor MUs, this activity would have to occur after all the hydraulic dredging is completed. Therefore, the Marsh Island Restoration capital cost is scheduled for Project Year 5. The NAE estimated the cost for the Marsh Island Restoration in 2007 at \$2.61M. On 15 December 2008 EPA suggested increasing the cost to \$2.75M to cover oversight and other costs.

- Following completion of hydraulic dredging, equipment and facilities associated with hydraulic dredging in Areas C and D will be demobilized. The demobilization cost for Areas C and D is the escalated ROM estimate prepared by Jacobs in December 2007 (\$9,875,524) and includes complete demobilization and decontamination of equipment. This cost is carried in Year 6; the activity will occur after completion of hydraulic dredging this year.

ALTERNATIVE 2, \$15M/YEAR FUNDING SCENARIO

Alternative 2 is Alternative 1 plus the proposed Lower Harbor CAD Cell (LHCC) remedy. The proposed LHCC remedy would allow approximately 300,000 CY of contaminated sediment to be mechanically dredged from MUs 25-37 (theoretical volume is 271,000 CY from *Volumes, Areas and Properties of Sediment by Management Units*), transported down river by scow, and disposed in a cell beneath the Acushnet River. The removal of contaminated sediments by hydraulic dredging with two disposal methods, as currently allowed in the ROD, would be performed for the upper harbor MUs.

In the \$15M/year funding scenario of Alternative 2, the LHCC activities would take place first while the City has the LHCC area available. Finalization of the CAD Cell design and construction of the LHCC would take place in Project Year 1, the equipment required for mechanical dredging and LHCC disposal would be purchased in Project Year 2, the silt curtain would be constructed in Project Years 3 and 4, the mechanical dredging and disposal into the LHCC would take place in Project Year 5, and the LHCC would be capped and the silt curtain would be removed in Project Year 6.

Once the LHCC is completed, the hydraulic dredging, T&D and CDF activities will commence, in a sequence similar to the sequence in Alternative 1, \$15M/year funding scenario, with the volume adjustments made for the lower harbor MU sediments disposed in the LHCC. CDF A will be constructed in Project Years 7-9, and hydraulic dredging with T&D to a certified landfill will resume in Project Years 10-15.

CDF B will be constructed in Project Years 16 and 17 and CDF C will be constructed in Project Years 23-25. Hydraulic dredging and filling of the CDFs will be completed in Project Year 34.

At the conclusion of the dredging activities in each MU, confirmational sampling will be performed to allow movement of the sheet piles and dredge to the next MU. A cost of \$250,000 for confirmational sampling (total) was estimated at a discussion on 01 February 2009 with EPA, NAE and Jacobs. For the purposes of this cost estimate, the \$250,000 is divided evenly over the 21 dredging years for an annual confirmational sampling cost. The wetlands confirmational sampling is included in the wetlands remediation unit rate.

Wetlands Remediation will occur in Project Years 37-39, after hydraulic dredging and Marsh Island Restoration are completed. A detailed cost estimate for wetlands

restoration was developed for EPA in December 2007 (“Cost Estimate 1b”). The estimate included building temporary roads to access the wetlands, removal and T&D of material, backfilling, planting, and temporary road removal. The 2007 cost estimate was modified in April 2009 for the Alternative #4 One CAD Cell Approach cost estimate by adjusting the wetlands area from *Volumes, Areas and Properties of Sediment by Management Units*, likewise adjusting linear feet of access roads, and including installation of silt curtains around the excavation areas. The NAE estimated the cost for the Marsh Island Restoration in 2007 at \$2.61M. On 15 December 2008 EPA suggested increasing the cost to \$2.75M to cover oversight and other costs.

In addition to the construction of the LHCC and CDFs and installation of CDF monitoring wells, the following capital costs have been included in this cost estimate.

- Narragansett LTM is performed periodically by EPA, and for Alternative 2 \$15M/year is scheduled to be performed in Project Years 1 and 5. The basis for the cost is an EPA e-mail dated 23 January 2009 assuming the cost to be \$400,000 each event.
- The NStar Crossing is assumed to occur in Project Year 2. This is a cost for relocating power lines that pass under the Acushnet River and must be relocated to complete the dredging. The cost included in this estimate was increased from a 2007 estimate of \$1.2M due to an assumption that copper costs will increase. As discussed in a meeting with EPA, NAE and Jacobs on 01 February 2009, the estimate is \$3M in 2009 dollars.
- In Project Year 3, a capital cost has been included for re-competition of the TERC contract. The cost associated with re-competing the contract was provided by NAE in 2007 as \$983,404.
- In Project Year 40, Cell #1 at Area C will be emptied, the material shipped to a hazardous waste landfill, and the area will be capped. The cost of \$15,573,194 was derived from a similar estimate prepared by Jacobs in February 2008 for EPA, Cost Est 2bcf.
- Following completion of hydraulic dredging, equipment and facilities associated with hydraulic dredging in Areas C and D will be demobilized. The demobilization cost for Areas C and D is the escalated ROM estimate prepared by Jacobs in December 2007 (\$9,875,524) and includes complete demobilization and decontamination of equipment. This cost is carried in Year 41.

ALTERNATIVE 2, \$30M/YEAR FUNDING SCENARIO

This cost estimate was developed by applying a 3.5% annual escalation of cost each project year while maintaining a fixed funding level (i.e., not escalating the annual funding), per EPA assumption of funding level. The \$30M/year funding level was

exceeded in some years to accommodate minimum number of hydraulic dredge days, or when specific tasks required completion in a specific year or within a reasonable timeframe. To maintain an average annual cost of \$30M while escalating the annual costs, the project lifetime increased from 16 years to 27 years.

Alternative 2 is Alternative 1 plus the proposed Lower Harbor CAD Cell (LHCC) remedy. The proposed LHCC remedy would allow approximately 300,000 CY of contaminated sediment to be mechanically dredged from MUs 25-37 (theoretical volume is 271,000 CY from *Volumes, Areas and Properties of Sediment by Management Units*), transported down river by scow, and disposed in a cell beneath the Acushnet River. The removal of contaminated sediments by hydraulic dredging with two disposal methods, as currently allowed in the ROD, would be performed for the upper harbor MUs.

In the \$30M/year funding scenario of Alternative 2, the LHCC would be built first while the City has the LHCC area available. Finalization of the CAD Cell design and construction of the LHCC would take place in Project Year 1, the equipment required for mechanical dredging and LHCC disposal would be purchased in Project Year 2, the silt curtain would be constructed in Project Years 2 and 3, the mechanical dredging and disposal into the LHCC would take place in Project Year 4, and the LHCC would be capped and the silt curtain would be removed in Project Year 5. In the \$30M/year funding scenario, hydraulic dredging can continue while the LHCC is built and filled.

The hydraulic dredging, T&D and CDF activities will commence in Year 2 and occur concurrently with LHCC activities. The dredging will occur in a sequence similar to the sequence in Alternative 1, \$30M/year funding scenario, with the volume adjustments made for the lower harbor MU sediments disposed in the LHCC. Hydraulic dredging and dewatering occur in Years 3-18; hydraulic dredging occurs in 16 of the project years. Capping of the CDFs and remediation of the wetlands, Marsh Island, and Cell #1 are performed in Years 19-27 for the purpose of this cost estimate. Some of these activities could occur simultaneous with hydraulic dredging.

CDF A will be constructed in Project Years 1 and 2 to receive the sand from the hydraulic dredging in Project Year 3. CDF C will be constructed in Project Years 4-8 and CDF B will be constructed in Project Years 12-15. Hydraulic dredging and filling of the CDFs will be completed in Project Year 18. The cost for capping all three CDFs is included in Year 19 for the purposes of this cost estimate, but in practice each cap would be constructed as each CDF is filled. In the final year of construction of each CDF, a capital cost is included for installation of monitoring wells to perform LTM of each CDF. Monitoring of each CDF will commence the first year material is placed in the respective CDF. For the purposes of this cost estimate, the CDF LTM is carried only through the project lifetime; in reality, CDF LTM would continue beyond the project lifetime.

At the conclusion of the dredging activities in each MU, confirmational sampling will be performed to allow movement of the sheet piles and dredge to the next MU. A cost of \$250,000 for confirmational sampling (total) was estimated at a discussion on 01 February 2009 with EPA, NAE and Jacobs. For the purposes of this cost estimate, the

\$250,000 is divided evenly over the 16 dredging years for an annual confirmational sampling cost. The wetlands confirmational sampling is included in the wetlands remediation unit rate.

Wetlands Remediation will occur in Project Years 23-27, after hydraulic dredging, demobilization and Marsh Island Restoration are completed. A detailed cost estimate for wetlands restoration was developed for EPA in December 2007 ("Cost Estimate 1b"). The estimate included building temporary roads to access the wetlands, removal and T&D of material, backfilling, planting, and temporary road removal. The 2007 cost estimate was modified in April 2009 for the Alternative #4 One CAD Cell Approach cost estimate by adjusting the wetlands area from *Volumes, Areas and Properties of Sediment by Management Units*, likewise adjusting linear feet of access roads, and including installation of silt curtains around the excavation areas. The NAE estimated the cost for the Marsh Island Restoration in 2007 at \$2.61M. On 15 December 2008 EPA suggested increasing the cost to \$2.75M to cover oversight and other costs.

In addition to the construction of the LHCC and CDFs and installation of CDF monitoring wells, the following capital costs have been included in this cost estimate.

- Narragansett LTM is performed periodically by EPA, and for Alternative 2 \$30M/year is scheduled to be performed in Project Years 1 and 5. The basis for the cost is an EPA e-mail dated 23 January 2009 assuming the cost to be \$400,000 each event.
- The NStar Crossing is assumed to occur in Project Year 2. This is a cost for relocating power lines that pass under the Acushnet River and must be relocated to complete the dredging. The cost included in this estimate was increased from a 2007 estimate of \$1.2M due to an assumption that copper costs will increase. As discussed in a meeting with EPA, NAE and Jacobs on 01 February 2009, the estimate is \$3M in 2009 dollars.
- In Project Year 3, a capital cost has been included for re-competition of the TERC contract. The cost associated with re-competing the contract was provided by NAE in 2007 as \$983,404.
- In Project Years 22-24, Cell #1 at Area C will be emptied, the material shipped to a hazardous waste landfill, and the area will be capped. The cost of \$15,573,194 was derived from a similar estimate prepared by Jacobs in February 2008 for EPA, Cost Est 2bcf.
- Following completion of hydraulic dredging, equipment and facilities associated with hydraulic dredging in Areas C and D will be demobilized. The demobilization cost for Areas C and D is the escalated ROM estimate prepared by Jacobs in December 2007 (\$9,875,524) and includes complete demobilization and decontamination of equipment. This cost is carried in Years 20 and 21.

ALTERNATIVE 2, \$80M/YEAR FUNDING SCENARIO

Alternative 2 is Alternative 1 plus the proposed Lower Harbor CAD Cell (LHCC) remedy. The proposed LHCC remedy would allow approximately 300,000 CY of contaminated sediment to be mechanically dredged from MUs 25-37 (theoretical volume is 271,000 CY from *Volumes, Areas and Properties of Sediment by Management Units*), transported down river by scow, and disposed in a cell beneath the Acushnet River. The removal of contaminated sediments by hydraulic dredging with two disposal methods, as currently allowed in the ROD, would be performed for the upper harbor MUs. Under the \$80M/year funding scenario, several activities have been assumed to occur simultaneously to take advantage of available funding. In years where total cost is less than \$80M the activities are restricted by sequencing of activities and number of work days per year.

For the purposes of this cost estimate, the 271,589 CY of in-situ sediment material from MUs 25-37 will be placed in the LHCC and capped. The sediment will be mechanically dredged and will not be dewatered prior to disposal.

The total capacity of the planned CDFs is approximately 210,000 CY. The sand from the dewatering operations (assumed to be 10% of the total hydraulically dredged sediment volume or 42,128 CY) will be disposed of in the CDFs. The remaining 167,872 CY capacity of the CDFs will be filled with filter cake. This leaves 63,829 CY of filter cake to be shipped to a certified landfill. T&D of filter cake will take place in Project Years 1 and 2 to allow construction of the CDFs and allow the less contaminated material to be disposed in the CDFs.

For the \$80M/year funding scenario of Alternative 2, the project lifetime is 6 years. Hydraulic dredging and dewatering occurs in Years 1 through 4; mechanical dredging occurs in Years 4 and 5. Wetlands remediation will begin in Project Year 4 and continue through Year 6. A detailed cost estimate for wetlands restoration was developed for EPA in December 2007 ("Cost Estimate 1b") and modified in April 2009 (Alternative #4).

At the conclusion of the mechanical and hydraulic dredging activities in each MU, confirmational sampling will be performed to allow movement of the sheet piles and dredge to the next MU. A cost of \$250,000 for confirmational sampling (total) was estimated at a discussion on 01 February 2009 with EPA, NAE and Jacobs. For the purposes of this cost estimate, the \$250,000 is divided evenly over the 5 dredging years for an annual confirmational sampling cost. The wetlands confirmational sampling is included in the wetlands remediation unit rate.

Construction of the CDFs and the monitoring wells for CDF LTM will begin in Project Year 1; filling and LTM will begin in Project Year 2. The sand from hydraulic dredging in Year 1 will be stockpiled while the first CDF is constructed. The CDFs will be filled as they are constructed. The rate of filter cake production during hydraulic dredging seasons will out-pace the rate of filling the CDFs. Therefore, filling the CDFs will

continue into Year 6 even though hydraulic dredging is completed in Year 4. The CDFs will be capped in Year 6.

Construction of the LHCC will begin in Year 1 and last three years. In Project Year 4, the equipment required for mechanical dredging and CAD cell disposal will be purchased, and mechanical dredging will begin. For the purposes of this cost estimate, it is assumed that mechanical dredging will take approximately 194 days. Therefore, due to available work days and multiple activities in Project Year 4, including installation of silt curtains around the CAD cell, it is assumed that mechanical dredging will carry over into Project Year 5. The CAD cell will be capped in Year 6 and silt curtains will be removed.

Areas C and D will be demobilized in Year 5 and Cell #1 at Area C will be emptied and capped, thus removing the dredging and dewatering activities from Areas C and D. Marsh Island Restoration will occur after hydraulic and mechanical dredging is completed, and is included in Project Year 6 for the purposes of this cost estimate.

The following capital costs have also been included in this cost estimate.

- The CAD Cell design is currently in draft form and will require finalization. For the purposes of this cost estimate, the cost to finalize the design is included in Project Year 1. The cost to finalize the design is estimated at \$67,248, which is the escalated actual cost of the draft design incurred in 2006.
- Similar to Alternative 1 \$80M/year scenario, Narragansett LTM is scheduled to be performed in Project Years 1 and 5 for Alternative 2 \$80M/year. The basis for the cost is an EPA e-mail dated 23 January 2009 assuming the cost to be \$400,000 each event.
- The NStar Crossing is assumed to occur in Project Year 2. This is a cost for relocating power lines that pass under the Acushnet River and must be relocated to complete the dredging. The cost included in this estimate was increased from a 2007 estimate of \$1.2M due to an assumption that copper costs will increase. As discussed in a meeting with EPA, NAE and Jacobs on 01 February 2009, the estimate is \$3M in 2009 dollars.
- In Project Year 3, a capital cost has been included for re-competition of the TERC contract. The cost associated with re-competing the contract was provided by NAE in 2007 as \$983,404.

COMPARISON OF ALTERNATIVES

Alternative	Funding Scenario	Net Present Value	Project Lifetime
1	\$15M/year	\$413M	46 years
1	\$30M/year	\$452M	20 years
1	\$80M/year	\$454M	6 years
2	\$15M/year	\$376M	41 years
2	\$30M/year	\$389M	16 years
2	\$80M/year	\$393M	6 years